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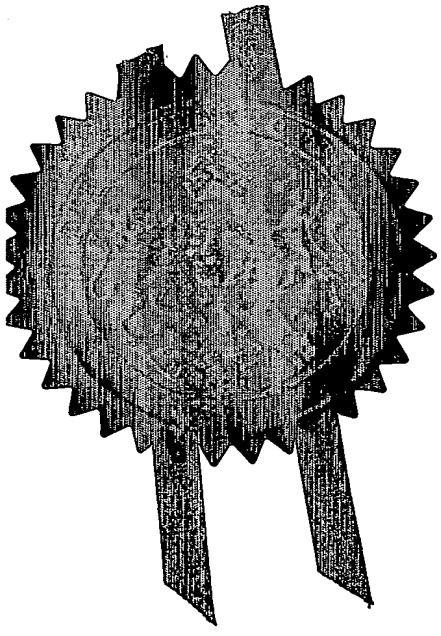

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Dated 8 May 2003

Rule 4(1)

Patents Form 1/77

Patents Act 1977
(Rule 16)

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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1.	Your reference	BS/DMC/LP01891UK	
2.	Patent application number *(The Patent Office will fill in this part)* 02 JUL 2002 0215254.4	02JUL02 E730267-3 D00291 P01/7700 0.00-0215254.4	
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	BL-Pegson Limited Mammoth Street Coalville Leicester LE67 3GN	
	Patents ADP number *(if you know it)* 08318625001		
	If the applicant is a corporate body, give the country/state of its incorporation	England	
4.	Title of the invention	Jaw Crusher	
5.	Name of your agent *(if you have one)*	**Lewis & Taylor**	
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	**144 New Walk** **Leicester** **LE1 7JA**	
	Patents ADP number *(if you know it)*	**711002** ✓	
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)* / Date of filing *(day / month / year)*
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.*	yes	

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	9
Claim(s)	1
Abstract	
Drawing(s)	2 + 2 RW

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translation of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature: Luis Spoor

Date: 1 July 2002

12. Name and daytime telephone number of person to contact in the United Kingdom: Brian Spoor (0116) 233 8181

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TITLE: Jaw Crusher

The present invention relates to a jaw crusher, more particularly, but not exclusively, to a jaw crusher for crushing rock material.

Quarried material is often processed by means of crushing plant, for the production of aggregate, for example. There are various known forms of crushing plant for the comminution of rock material, one of which is referred to as a jaw crusher.

One conventional jaw crusher consists of a frame having a pair of jaws, a fixed jaw and a swing jaw, each jaw having a crushing face, with the crushing faces arranged in a spaced apart relationship, to define a crushing chamber for receiving rock material to be crushed. The swing jaw is movable between a first position, in which the crushing face of the swing jaw is inclined to the crushing face of the fixed jaw, and a second position in which the crushing face of the swing jaw is brought substantially parallel to the crushing face of the fixed jaw, at a predetermined spacing from one another. Hence, in the first position, the crushing chamber is substantially v-shaped.

The upper end of the swing jaw is connected to an eccentric shaft, located in a rotatable bearing. In use, as the bearing is rotated, the shaft is caused to proscribe a circle, which in turn causes the upper end of the swing jaw to proscribe a circle in the direction of the fixed jaw, in a cycle between the first and second positions. Hence, the crushing face of the swing jaw moves up and down, as well as towards and away from the crushing face of the fixed jaw. Movement of the swing jaw in this manner causes impelling forces for crushing of material present in the crushing chamber. The spacing between the crushing faces of the two jaws is set at a predetermined distance, dependent on the size of material which is required as a result of the crushing process. Hence, a greater spacing between the two jaws will result in larger pieces of crushed material being produced as part of the crushing process than the smaller pieces which would be produced by using a smaller jaw spacing.

Typically, a jaw crusher as described above will include a toggle plate located adjacent the lower end of the swing jaw for supporting the lower end of the swing jaw during the crush cycle. In a known type of jaw crusher, one end of the toggle plate reacts against the rear face of the swing jaw, and the other end of the toggle plate reacts against a cross beam provided behind the swing jaw and extending between the walls of the jaw crusher frame.

To enable a predetermined maximum product size to be produced during the crush cycle, the spacing between the pair of jaws at their lower ends, i.e. where the crushed material is discharged during the crush cycle, can be adjusted. It is known to insert or remove shim packs or other adjustment means between the toggle plate and the cross beam, thus reducing or increasing the distance between the lower ends of the pair of jaws.

If an uncrushable object enters the crushing chamber, during the crushing cycle, substantial forces are generated as the swing jaw acts to complete its cyclic motion against the uncrushable object, which can cause damage to the jaw crusher, and which can be dangerous to remove. In some cases, the substantial forces generated will cause the toggle plate to yield, which renders the jaw crusher inoperative until the toggle plate is replaced, therefore having productivity and/or economic implications.

GB812507 describes a jaw crusher substantially as described above which teaches a solution to these problems. In this case, the cross beam is slidably mounted in the walls of the jaw crusher frame. The ends of the cross beam extend through the walls of the jaw crusher frame and carry bearing blocks, each bearing block having a tie rod attached thereto. The tie rods extend away from the bearing blocks, in the direction of the fixed jaw, and are each secured at their other end to a crosshead located on the outside of the respective wall of the jaw crusher frame. A pair of pressure cylinders are mounted in parallel, in line with the tie rods, one on either side of the jaw crusher frame, between the associated crosshead and bearing block. Each cylinder includes a piston rod which is attached to a respective crosshead, wherein the piston rods work in their respective cylinder, under pressure, with each cylinder being in communication with a hydraulic control system.

Under normal operating conditions, the cylinders act to push the crossheads forwards, i.e. in the direction of the fixed jaw, thereby pulling the tie rods in a direction away from the bearing blocks, thus putting the tie rods in tension, to bias the cross beam in the direction of the fixed jaw in its slidable mounting.

When excessive pressure is generated in the crushing chamber, for example when an uncrushable object enters the crushing chamber, the swing jaw is forced backwards, i.e. away from the fixed jaw, against the toggle plate to urge the cross beam to slide backwards in the side walls. This movement acts against the counter action of the cylinders transmitted through the tie rods and crossheads. The hydraulic control system provides a hydraulic buffer for the crossbeam and toggle plate against overload during the crushing cycle, to allow movement of the cross beam within the jaw crusher arrangement, when excessive pressure is generated, to avoid an inertial yield of the toggle plate.

However, the arrangement has the disadvantage that, since the tie rods and associated cylinders are outside the walls of the jaw crusher frame, the action of the cylinders puts the cross beam into bending, under normal operating conditions. If excessive pressures are generated during the crush cycle, as described above, the action of the toggle plate against the cross beam causes bending stresses in the crossbeam, which significantly magnifies the bending effect of the tie rods on the cross beam. Given the immense bending stresses which are associated with an uncrushable object entering the crushing chamber, this known arrangement is not considered to be satisfactorily practical or safe, and does not effectively absorb the magnitude of the generated forces. In addition, the magnitude of the forces involved dictates that the cylinders must, in practice, be of a very large diameter, which increases the offset distance of the line of action of the cylinders from the side walls, thus increasing the additional bending stresses still further.

US4927089 describes a jaw crusher which teaches an alternative solution to the problems referred to above. A plurality of parallel hydraulic cylinders are provided between the cross beam and the toggle plate in communication with an hydraulic circuit having a pressure relief device, such that, once a pre-set pressure is reached in the cylinders, due to an uncrushable object being present in

the crushing chamber, hydraulic fluid is released from each cylinder via the relief device, which allows the swing jaw to be moved away from the fixed jaw, to enable the uncrushable object to be passed through the chamber.

However, due to the substantial pressures generated in the cylinders as part of the crushing process, typically from zero to a maximum pressure with every cycle of the swing jaw, seal life within the cylinders can be compromised. Furthermore, hydraulic fluid is compressible to a degree, and therefore crushing efficiency can be compromised, as the cylinders compress the fluid during the crushing cycle, for example.

It is an object of the invention to reduce the disadvantages referred to above.

According to the present invention, there is provided a jaw crusher for crushing rock material, comprising a frame having a fixed jaw and a swing jaw, between which is defined a crushing chamber for receiving material to be crushed, the swing jaw being mounted for cyclic movement in the direction of the fixed jaw, a toggle plate for operative communication between a rear portion of the swing jaw and a cross beam adjustably disposed in the transverse axis of the frame, and an hydraulic cylinder arrangement located behind and in operative communication with the cross beam, in which, in use, the hydraulic fluid is pressurised to a predetermined value to provide an adjustably pre-loaded reaction against the action of the toggle plate.

Conveniently, the hydraulic cylinder arrangement is pre-loaded against a part of the frame.

In a preferred embodiment of the invention, the hydraulic cylinder arrangement consist of a pair of cylinders, in parallel, each of which is located in an aperture in a respective wall of the frame, in which the cross beam is adjustably received.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view from the side of part of a jaw crusher according to the invention, showing part of the jaw crusher in cross-section; and

Figure 2 is a diagrammatic cross-sectional view from above of the jaw crusher shown in Figure 1.

Referring to the figures, a jaw crusher assembly is generally indicated at 10, which includes a frame 11 having a pair of opposing walls 12, 14. A pair of jaws, a fixed jaw 16 and a swing jaw 18, are supported between the opposing walls 12, 14. The jaws 16, 18, are of conventional construction and are both provided with a wear surface 20. The upper end of the wear surface 20 is removably secured on a respective jaw 16, 18 by a bolt 22, and the lower end of each wear surface 20 engages a lip 24 provided on the lower end of each jaw 16, 18. Each wear surface 22 defines a crushing face on a respective jaw 16, 18, the two crushing faces defining a crushing chamber 26, for receiving material to be crushed, for example the rock material 28 shown in Figure 2.

The upper end of the swing jaw 18 is connected to the jaw crusher assembly 10 in a known manner by a shaft 30 having a first axis 32, which is rotatably received in a bearing 34. The portion of the shaft 30 which is received in the bearing 34, is disposed eccentrically with respect to the remainder of shaft 30 (not visible). The shaft 30 is rotatably driven by a fly wheel 36, such that rotation of the shaft 30 causes circular motion of the upper end of the swing jaw 18 in the direction of the fixed jaw 16. The mounting and movement of the upper end of the swing jaw 18 on the jaw crusher assembly 10 is wholly conventional and shall not be described in any further detail.

Each wall 12, 14 includes an elongate aperture indicated at 40, the outline of one aperture 40 being visible in Figure 1. A cross beam 42 extends in the transverse axis of the jaw crusher assembly 10, as can be seen in Figure 2, with the ends of the cross beam 42 being received through a respective aperture 40. A plate 44 having a flange 46 is secured to the underside of the cross beam 42, located substantially centrally with respect to the transverse axis of the jaw crusher assembly 10. A tie rod 48 extends through the flange 46, the left hand end of which, as viewed, is pivotally

connected to the lower end of the swing jaw 18. As can be seen, a spring 50 is provided between the free end of the tie rod 48, to the right as viewed in the Figures, and the flange 46. The spring 50 is secured in place by a lock nut 52 in threaded connection with the free end of the tie rod 48.

A toggle plate 54 is provided between the rear face of the swing jaw 18 and the cross beam 42, respective ends of the toggle plate 54 being movably received in a toggle seat 56 provided on each of the cross beam 42 and the swing jaw 18 for communication therewith. The toggle seats 56 have an arcuate internal profile against which the respective ends of the toggle plate 54 are in contact. The ends of the toggle plate 54 have an arcuate profile which is shallower than that of each toggle seat 56, the toggle plate 54 thereby being able to self-centre the toggle seats 56.

An hydraulic cylinder arrangement consisting, in this embodiment, of a pair of hydraulic cylinders 60, in parallel, are provided for operative engagement with the rear of the cross beam 42, to the right as viewed in the Figures. Each hydraulic cylinder 60 consists of a cylinder 62 and a piston 64 which is operatively reciprocable within the cylinder 62. Each piston 64 includes an articulatable seating face 66 for engagement with the cross beam 42. The hydraulic cylinders 60 are each received in a respective aperture 40 and are each provided with relief and supply lines 68 connected to an hydraulic fluid circuit (not shown). A plurality of seals are provided between the walls of each cylinder 62 and a respective piston 64 to maintain an operative chamber for the hydraulic fluid within each cylinder 60. As can be seen in Figure 1, the closed end of the cylinders 62 have a complimentary profile to the curved ends of the apertures 40. As can be seen in Figure 2, the cylinders are in line with the walls 12, 14 of the frame 11.

A shim pack 70, consisting of a plurality of removable shim plates, is provided in each aperture 40, in contact with the front of the cross beam 42. An insert 72 is provided in each aperture, to the right of the shim pack as viewed in the Figures, having a planar face for contact with the shim pack 72 and a curved face for complimentary engagement with the curved profile of the right hand end of the aperture 40.

In use, rotation of the shaft 30 causes cyclic movement of the swing jaw 18 between a first position, in which the crushing face of the swing jaw 18 is inclined to the crushing face of the fixed jaw 16, as shown in Figure 1, and a second position in which the crushing face of the swing jaw 18 is brought substantially parallel to the crushing face of the fixed jaw 16, as shown in Figure 2, at a predetermined spacing from one another. Hence, in use, the crushing face of the swing jaw 18 moves in a crushing cycle, up and down, as well as towards and away from the crushing face of the fixed jaw 16. Material to be crushed is introduced into the crushing chamber 26 through the top of the jaw crusher assembly 10 and crushed material is discharged through the spacing between the lower end of the two jaws 16, 18. The cyclic movement of the swing jaw 18, as described above, causes impelling forces for crushing the material present in the crushing chamber 26.

In the first position, in the absence of crushing material, the lower end of the swing jaw 18 is biassed by the tie rod 48 and spring 50 into a position at the predetermined spacing from the lower end of the fixed jaw 16. Further, the toggle plate 54 is clamped between the toggle seats 56, by the biassing action of the tie rod 48 and spring 50.

In use, the hydraulic cylinders 60 are pressurized to a predetermined value, for example 400 bar, against the inserts 72, through the cross beam 42 and the shim pack 70, ultimately against the right hand end of the aperture 40, as viewed in the Figures. As a crushing force is generated, during the cyclic movement of the swing jaw 18 in the direction of the fixed jaw 16, load from the crushing chamber 26 is passed through the toggle plate 54 against the cross beam 42 and on to the hydraulic cylinders 60. Hence, the hydraulic cylinders 60 provide a pre-loaded reaction, in line with the walls 12, 14 of the frame 11, against action of the toggle plate 54 with the cross beam 42, against the left hand end of the aperture 40 as viewed in the Figures.

The benefit of this arrangement is that, during a typical crush cycle, the pressure in the hydraulic cylinders 60 remains substantially constant with the applied toggle plate load on the cross beam 42, increasing the life of the seals within each hydraulic cylinder 60. Furthermore, the load from the cylinders acts in line with the reaction points (i.e. the shim packs), and therefore no substantial additional stresses are generated in the cross beam 42. In addition, the load from the cylinders is

transferred directly on to, and in line with, the crusher side plates. This greatly reduces the stresses within the crusher frame for any given weight of structure. Hence, the design of the jaw crusher is substantially compact, which has significant advantages when used on a mobile crusher plant. For example, the mobile chassis can be significantly narrower than is conventionally available, thus reducing the weight and increasing the movability of the plant.

If an uncrushable object enters the crushing chamber 26, during the crushing cycle, substantial forces are generated as the swing jaw 18 acts to complete its cyclic motion against the uncrushable object, which can cause damage to the jaw crusher assembly 10, and which can be dangerous to remove. However, the hydraulic cylinders 60 provide an adjustable reaction for the toggle plate 54 during the crush cycle.

If the pressure generated during the crushing cycle becomes excessive, for example in an overload situation where an uncrushable object is present in the crushing chamber 26, the load applied to the cross beam 42 via the toggle plate 54 will exceed the pre-loaded pressure of the hydraulic cylinders 60. A relief valve is provided in the hydraulic circuit, which, when the pre-loaded value is exceeded, allows fluid under pressure to be released from the hydraulic cylinders 60. In this case, each piston 64 can be pushed backwards into a respective cylinder 62, to the left as viewed, to enable the swing jaw 18 to move away from the fixed jaw 16 to allow the crushing chamber 26 to be cleared safely.

The spacing between the lower end of the two jaws 16, 18 is set at a predetermined distance, dependent on the size of material which is required as a result of the crushing process. Hence, a greater spacing between the two jaws 16, 18 will enable a larger sized pieces of crushed material to be passed downwards through the crushing chamber 26 during the crushing cycle than a smaller spacing. To enable a predetermined maximum product size to be produced during the crush cycle, the spacing between the lower end of the pair of jaws 16, 18, i.e. where the crushed material is discharged during the crush cycle, can be adjusted by inserting or removing shim plates from the shim packs 72, thus reducing or increasing the distance between the lower ends of the pair of jaws 16, 18.

To adjust the spacing between the lower ends of the jaws 16, 18 it is first necessary to release the pressure from the cylinder arrangements 60 and to push the pistons 64 back in to the cylinders 62. The cross beam 42 is then withdrawn from the shim pack 70, to the left as viewed in the Figures, to enable shim plates to be removed or added, as required. The cylinder arrangements 60 are then pressurized to the pre-load value to bring the cross beam 42 back into contact with the shim pack 70.

The adjustability of the spacing between the jaws 16, 18 is also advantageous after a period of crushing, where components of the jaw crusher become worn, leading to an increase in the spacing between the lower ends of the jaws 16, 18. For example, the wear surfaces 20 and/or toggle seats may become worn, thus increasing the spacing between the lower ends of the jaws 16, 18. In such an instance, it will be necessary to reduce the spacing to the predetermined spacing for the required maximum crushed product size, for example by inserting shim plates.

Whilst the invention has been described with reference to the use of shim packs to provide adjustability of the spacing between the lower ends of the swing jaw and fixed jaw, it will be appreciated that other suitable adjustment means can be used, for example a plurality of wedges.

Claims

1. A jaw crusher for crushing rock material, comprising a frame having a fixed jaw and a swing jaw, between which is defined a crushing chamber for receiving material to be crushed, the swing jaw being mounted for cyclic movement in the direction of the fixed jaw, a toggle plate for operative communication between a rear portion of the swing jaw and a cross beam adjustably disposed in the transverse axis of the frame, and an hydraulic cylinder arrangement located behind and in operative communication with the cross beam, in which, in use, the hydraulic fluid is pressurised to a predetermined value to provide an adjustably pre-loaded reaction against the action of the toggle plate.

2. A jaw crusher as claimed in claim 1, in which the hydraulic cylinder arrangement is pre-loaded against a part of the frame.

3. A jaw crusher as claimed in claim 1 or claim 2, in which the hydraulic cylinder arrangement consist of a pair of cylinders, in parallel, each of which is located in an aperture in a respective wall of the frame, in which the cross beam is adjustably received.

Figure 1

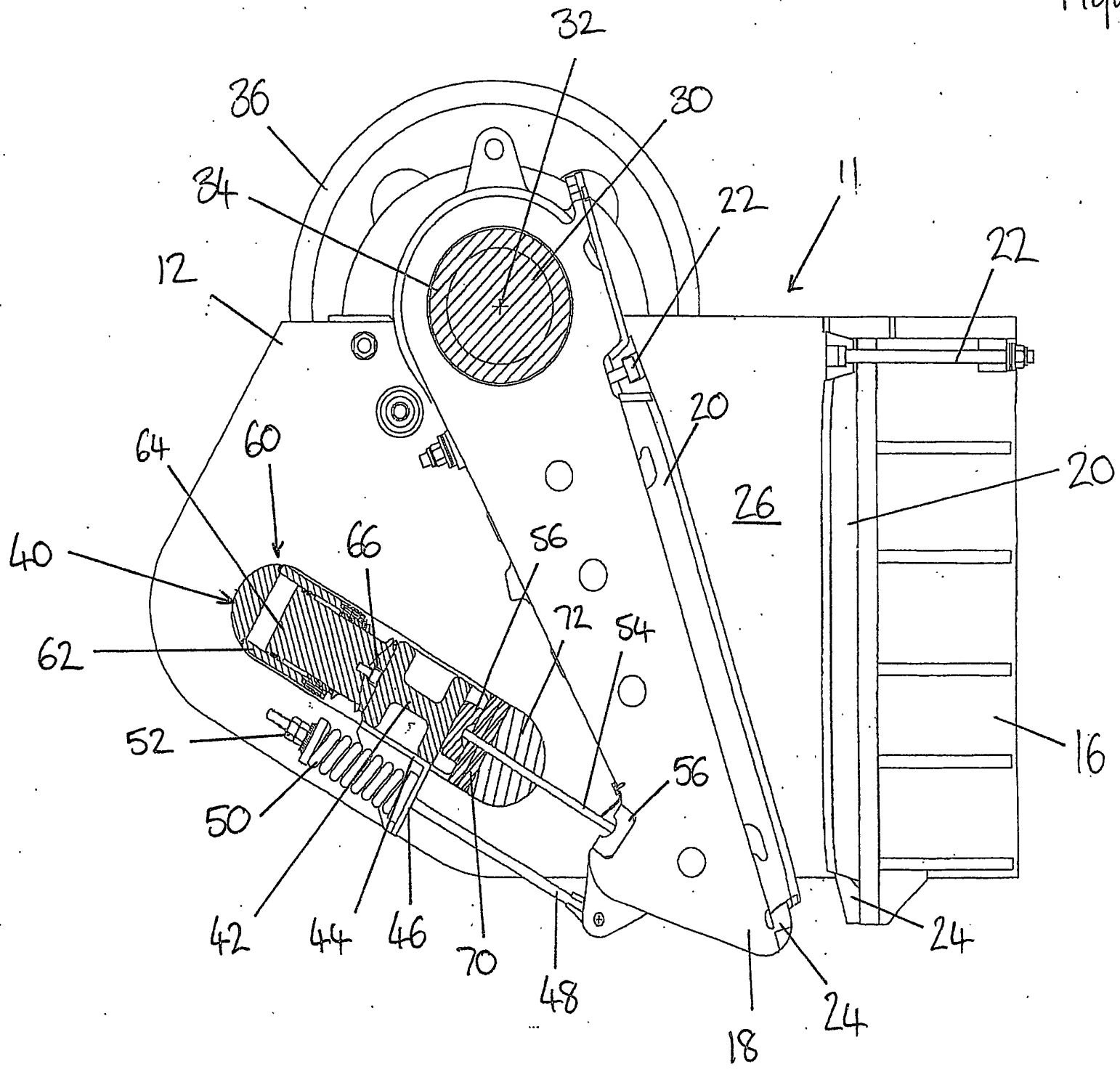
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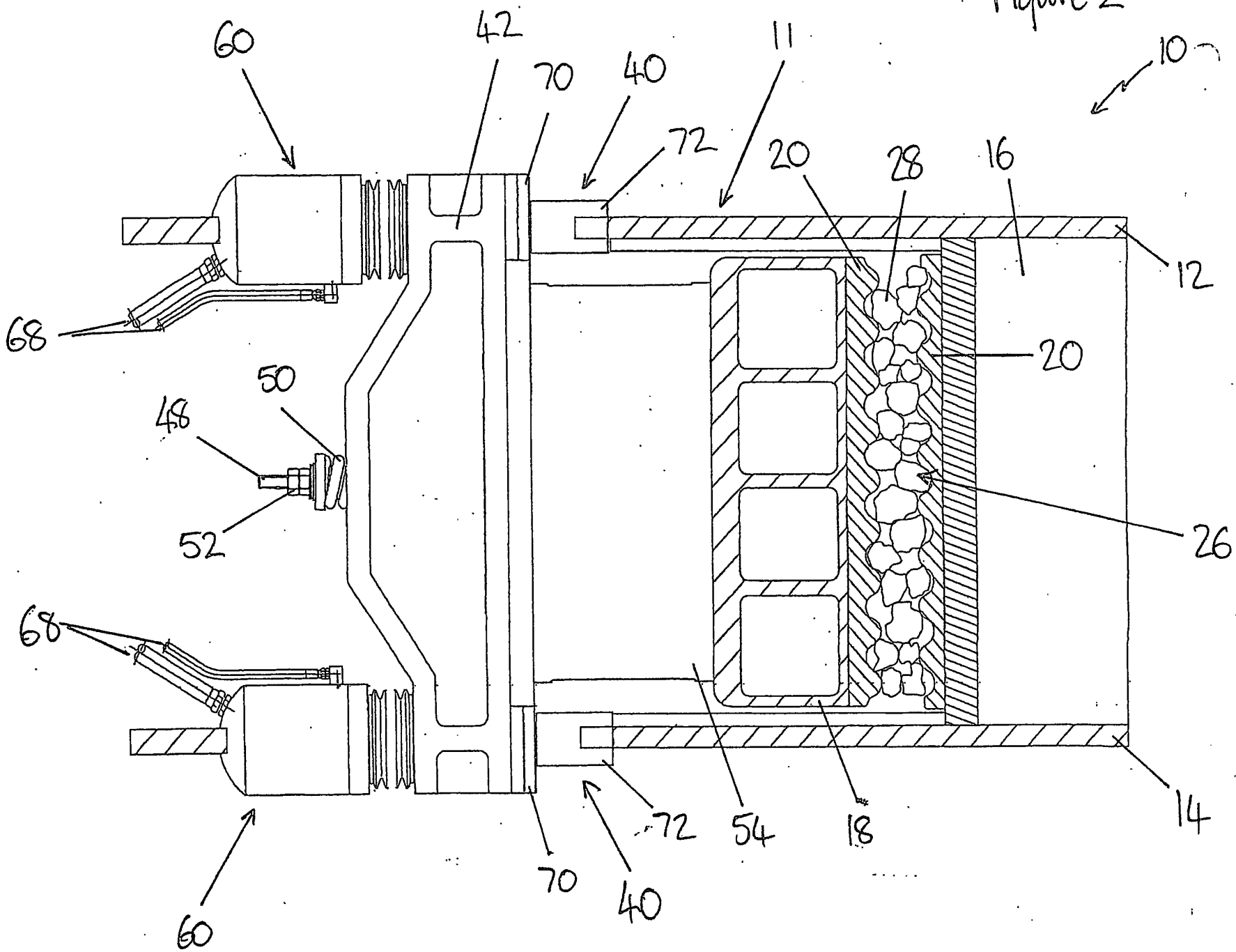
Figure 2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